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Progress;' Mr. W. Gowland, three lectures on 'The Art of Working Metals in Japan;' Dr. Robert Munro, two lectures on 'Lake Dwellings;' Mr. E. A. Wallis Budge, of the British Museum, two lectures on 'The Moral and Religious Literature of Ancient Egypt.' The first lecture of the Friday evening course will be by M. G. Lippmann, on 'Color Photography.'

WE learn from the London *Times* that the report of the Meteorological Council for the year ending March 31, 1895, submitted to the President and Council of the Royal Society, has just been issued as a Parliamentary paper. Of the forecasts issued at 8:30 p. m., in the year 1894-1895, the percentage of complete success was 56, of partial success 27, of partial failure 12, and of total failure 6. The average for the ten years from 1885 to 1894 was 51·2 of complete success and 30·7 of partial success. The storm warnings show a percentage of 68·5 of success and 23·5 of partial success. The warnings not justified by subsequent weather were 6 per cent. These figures show a marked improvement on those for the years from 1885 to 1893 inclusive. The hay harvest forecasts show a total percentage of 89 of complete or partial success. The Council express their regret that the experiment of exhibiting, at telegraphic stations in rural districts every afternoon, the daily weather forecasts is not to be repeated. The net expenditure of the Council in 1894-95 was £15,212 0s. 11d., as compared with £15,969, 7s. 6d. in 1893-94. The sum of £1,528 0s. 10d., was paid to the postoffice for services rendered. The income of the Council was £15,300, granted by Parliament, and £721 19s. 6d., received from various other sources.

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. ELIZABETH MARY LUDLOW, the mother of the late Robert Center, has given his estate, valued at \$150,000, to Columbia University for the purpose of endowing the 'Robert Center Fund for Instruction of Music.'

THE Teachers' College, New York, has received from a donor whose name is at present withheld, a gift of \$250,000 to complete the present group of buildings. This will make the value

of the property on Morningside Heights, adjacent to the grounds of Columbia University, about \$1,000,000, and will add greatly to the facilities of the College and of Columbia University, to which it is affiliated.

MR. W. C. McDONALD, whose gift of \$500,000 to McGill University was reported in this journal last week has now given, in addition, \$150,000, to be used in maintaining the engineering and physics building.

THE annual report of President Dwight, of Yale University, for the year 1895, states that gifts to the University during the year have amounted to \$305,301.

THE Senate of Deans of the Catholic University of Washington has decided to establish an Institute of Technology. It is proposed to construct a special building for the purpose.

THE following instructors have been appointed in Harvard University: Charles Montague Bakewell, A. M., in philosophy; James Edwin Lough, A. M., in experimental psychology; Charles Palache, Ph. D., in mineralogy; Robert Jay Forsythe, A. B., in metallurgy and metallurgical chemistry.

BARON EÖTVÖS has been made full professor of experimental physics in the University at Buda-Pesth.

DISCUSSION AND CORRESPONDENCE.

HEREDITY AND INSTINCT (II.)*

IN the earlier paper I argued from certain psychological truths for the position that two general principles recently urged by Romanes for the Lamarckian, or 'inherited habit,' view of the origin of instinct do not really support that doctrine. These two principles are those cited by Romanes under the phrases respectively 'co-adaptation' and 'selective value.' In the case of complex instincts these two arguments really amount to one, *i. e.*, as long as we are talking about the *origin* of instinct. And the one argument is this: that partial co-adaptations in the direction of an instinct are not of selective value; hence instinct could not have arisen by gradual

*Conclusion of paper of same title in SCIENCE March 20th.

partial co-adaptive variations, but must have been acquired by intelligence and then inherited. This general position is dealt with in the earlier article.

It will be remembered, however, that the force of the refutation of the Neo-Lamarckian argument on this point depends on the assumption, made in common with him, that some degree of intelligence or imitative faculty is present before the completion of the instinct in question. To deny this is, of course, to deny the contention that instinct is 'lapsed intelligence,' or 'inherited habit.' To assume it, however, opens the way for certain farther questions, which I may now take up briefly, citing Romanes by preference as before.

I. The argument from 'selective value' has a further and very interesting application by Romanes. He uses the very fact upon which the argument in my earlier paper was based to get more support for the inheritance of habits. The fact is this, that intelligence may perform the *same acts* that instinct does. So granting, he argues, that the intelligent performance of these acts comes first in the species' history, this intelligent performance of the actions serves all the purposes of utility which are claimed for the instinctive doing of the same actions. If this be true, then variations which would secure the instinctive performance of these actions do not have selective value, and so the species would not acquire them by the operation of natural selection. By the Lamarckian theory, however, he concludes, the habits of intelligent action give rise to instincts for the performance of the same actions which are already intelligently performed, the two kinds of function existing side by side in the same creature.*

This is an ingenious turn, and raises new questions of fact. Several things come to mind in the way of comment.

First. It rests evidently on the state of things required by my earlier argument against the Neo-Lamarckian claim that co-adaptation could not have been gradually acquired by variation; the state of things which shows the intelligence preventing the 'incidence of natural selection' by supplementing partial co-adaptation. Romanes now assumes that intelligence prevents

*Op. cit., pp. 74-81.

the operation of natural selection on further variations, and so rules out the origin of instinct through that agency, or, put differently, that actions which are of selective value when performed intelligently are not of selective value when performed also instinctively. But this seems in a measure to contradict the argument which is based on co-adaptations (examined in the earlier paper), *i. e.*, that instincts could not have arisen by way of partial co-adaptations at all. In other words, the argument from 'co-adaptation' asserts that the partial co-adaptations are not preserved, being useless; that from selective value asserts that they are preserved and, with the intelligence thrown in, are so useful as to be of selective value. We have seen that the latter position is probably the true one; but that the inheritance of acquired characters is then made unnecessary.

Second. Assuming the existence side by side in the same creature of the ability to do intelligently certain things that he also does instinctively, it is extraordinary that Romanes should then say that the instinctive reflexes have no utility additional to that of the intelligent performance. On the contrary, the two sorts of performance of the same action are of very different and each of extreme utility. Reflex actions are quicker, more direct, less variable, less subject to inhibition, more deep-seated organically, and so less liable to derangement. Intelligent actions—the same actions say—are, besides the points of opposition indicated, and by reason of them, more adaptable. Then there is the remarkable difference that intelligent actions are centrally stimulated, while reflex actions are peripherally stimulated. I cannot go into all these differences here; but the case may be made strong enough by citing certain divergencies between the two sorts of performance, with illustrations which show their separate utilities.

1. Reflex and instinctive actions are less subject to derangement. Emotion, injury, temporary ailment, hesitation, aboulia, lack of information, etc., may paralyze the intelligence; but instinct and reflex action may keep the creature alive in the mean time. What keeps dogs alive after extended ablations of the brain cortex?

2. Reflexes are quicker. Suppose instead of winking reflexly when a foreign body approaches the eye, I waited to see whether it was near enough to be dangerous, or even shut my eye as quickly as I could, I should join the ranks of the blind in short order.

3. Reflex actions are more deep-seated and arose genetically first. What keeps the infant alive and in touch with his environment before the voluntary fibers are developed? This genetic utility alone would seem critical enough to justify most of the genuine reflexes of the organism—supplemented, of course, by the mother!

4. Intelligent actions are centrally stimulated. This means that brain processes release the energy which goes out in movement, and that something earlier must stimulate the brain processes. This something is association in some shape between present stimulating agencies in the environment and memories, or pleasures and pains. In other words, certain central processes intervene between the outside stimulus and the release of the energies of movement. In reflexes, however, no such central influence intervenes. The stimulus in the environment passes directly—is reflected—into the motor apparatus. Hence the reflex is more direct, undeviating, invariable, sure. For example, research has recently proved that involuntary movements may be produced in a variety of normal circumstances, and in hysterical subjects, when the stimulation is too weak, or intermittent, or unimportant, to be perceived at all.

5. Experiments show that the energies of the two are not quantitatively the same. Mosso and Waller have shown that the muscles may work under direct stimulation after being quite exhausted for voluntary action, and *vice versa*. They may be exchanges of energy between the two circuits involved, which give the animal increased force in this reaction or that.

6. The intelligence could not attend to the necessary functions of life without the aid of reflexes, to say nothing of the luxuries of acquisition. So not to get the reflexes would prevent the growth of the intelligence. For example, suppose we had to walk, wink, breathe, swallow, scare away flies and mosquitoes, etc., all by voluntary attention to the

details and all at the same time. While chasing flies we should forget to breathe! And when should we have a moment's time to think? In this line it is in order to cite the experiments made on 'distraction,' which show that most of the common adaptations of life can go on by reflex and sub-conscious processes while the intelligence is otherwise occupied.*

7. Attention and voluntary intermeddling with reflex and instinctive functions tends to destroy their efficiency, bringing confusion and all kinds of disturbance.

These are all simple psychological facts, and more might be added showing that instinct has its own great utility even when the intelligence may perform the same actions in its own fashion. So it remains in each case to find out this utility and measure it, before we say that it is not of selective value. I should say that reflexes are generally of supreme importance and value; and if so, then natural selection may be appealed to to account for them. So, about all that remains of this argument of Romanes is the contribution which it makes to the refutation of his other one, from co-adaptations. The assumption of intelligence disposes of both the arguments, for the intelligence supplements slight co-adaptations and so gives them selective value; but it does not keep them from getting farther selective value as instincts, reflexes, etc., by farther variation.

II. But there is another very interesting question also to be settled by fact. Romanes and others cite simple reflexes as well as complex instincts as giving illustrations of the application of the principle of 'inherited habit' or 'lapsed intelligence'; and the cases which Romanes lays great stress on are the reflex actions of man's withdrawal of the leg from irritation to the soles, and the brainless frog's balancing himself.† The Neo-Lamarckian theory requires the assumption of intelligence for all of these. I have shown that granting the intelligence, that is just the assumption which in many cases enables us to discard the Lamarckian factor. But we may ask, is the assumption itself necessary for all reflexes?

*See Binet, *Alterations of Personality*, Part II., ch. 5. (Eng. trans. announced by Appletons.)

† Passage cited.

The question is too involved for treatment here; but the assumption that intelligence is necessary in any sense which make the *conscious voluntary* performance of the action always precede the reflex performance of it is very difficult to defend. For all that we know of the brain seat of voluntary intelligence, of the use of means to ends, etc., makes such action dependent in its origin upon the presence of the great mass of organic reflex processes which go on below the cortex. Complex associative processes must be genetically (and phylogenetically) later than the simple reflex processes, which, as has been intimated above, they presuppose.

But the more liberal definition of intelligence, which makes it include all kinds of conscious processes—the assumption of intelligence being the assumption of conscious process of some kind—that is a different matter. This supposition seems to be necessary on either theory of instinct, as I have argued;* for if we do not assume it, then natural selection is inadequate, as say Romanes and Cope; but if we do assume it, then the inheritance of acquired characters is unnecessary. On this simpler definition of intelligence, however, we find certain simpler states of consciousness, of which imitation is the most prominent example, serving nature a turn in the matter of development.

And on this wider view of intelligence the difference between intelligent (*i. e.*, imitative) action and instinctive reflex action is much greater than that pointed out in detail above between voluntary and reflex action. A word to show this may be allowed me, since it makes yet stronger the case against the special argument from selective fitness, which this paper set out to examine.

The differences between imitative action and reflex or instinctive action are not just those which we have found between voluntary and reflex actions. Imitation seems to be in a sense instinctive; and in the animals it seems to be, like the instincts, peripherally initiated. But

*See my article 'Consciousness and Evolution,' examining some parts of Prof. Cope's position, in SCIENCE, August 23, '95; reprinted kindly by him in the *American Naturalist*, March, '96, with reply in the succeeding issue of the latter journal.

it has a farther point of differentiation from the special instincts and reflexes, in that it is what has been called a 'circular' reaction, *i. e.*, it tends to reproduce the stimulus again—the movement seen, the sound heard, etc. There is always a certain comparability or similarity, in a case of conscious imitation, between the thing imitated and the imitator's result; and the imitation is unmistakably such in proportion as this similarity is real. We may say, therefore, that consciously imitative actions are confined to those certain channels of discharge with produce results comparable with the 'copy' which is imitated.

But the special instincts and reflexes are not so. They show the greatest variety of arrangement between the stimulus and the movement which results from it—arrangements which have grown up under the law of utility. They represent therefore special utilities which direct conscious imitation in each case, by the individual creature, could not secure; while conscious imitation represents a general utility more akin to that which we have seen the voluntary intelligence subserving.

If this be so, then we have to say that conscious imitation, while it prevents the incidence of natural selection, as has been seen, and so keeps alive the creatures which have no instincts for the performance of the actions required, nevertheless does not subserve the utilities which the special instincts do, nor prevent them from having the selective value of which Romanes speaks. Accordingly, on the more general definition of intelligence, which includes in it all conscious imitation, use of maternal instruction, and that sort of thing (the vehicle of 'social heredity')—no less than on the more special definition spoken of above—we still find the principal of natural selection operative and adequate, possibly, to the production of instincts and reflexes.*

J. MARK BALDWIN.

PRINCETON, March 17, 1896.

* This and the two preceding papers in this journal are not intended as more than preliminary statements of results thrown into the form of criticisms of particular views (*i. e.*, Romanes' and Prof. Cope's). For this reason I have not brought in reference to the general literature of the subject.